ENVIRONMENT

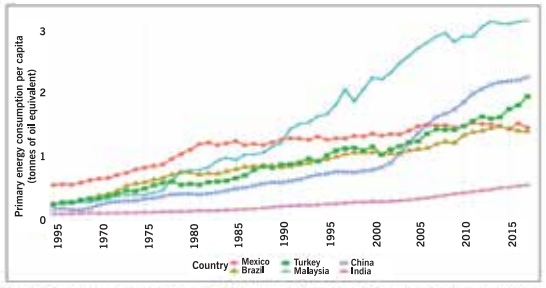


# RENEWABLE ENERGY AND ENERGY CONSERVATION

## Energy and its importance:

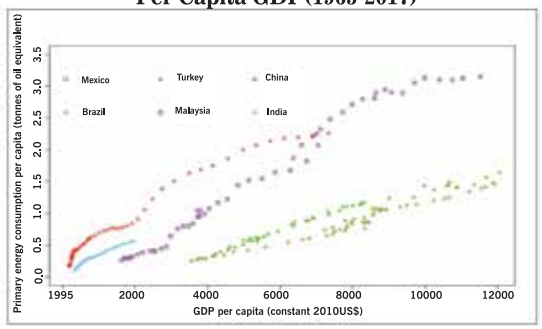
1. Energy is vital for development and prosperity of any economy.
2. 2018-19 Economic Survey argued that energy consumption is directly corelated to economic growth and development.

**Figure 1: Per Capita Primary Energy Consumption (1965-2017)**




Source: Data on primary energy comsumption from BP Energy Statistics, Population and Per-capita real GDP from World Bank Data.

**Figure 2: Per Capita Primary Energy Consumption Per Capita GDP(1965-2017)**




Source: Data on primary energy comsumption from BP Energy Statistics, Population and Per-capita real GDP from World Bank Data.

## In India:

India despite accounting for 18% of the world's population uses only around 6% of the world's primary energy.

India has a per capita energy consumption of only about one third of the global average.

The Economic Survey estimates that, with an increase of per capita energy consumption by 2.5 times, India will be able to increase its real per capita GDP by US$ 5000 (in 2010 prices).

While the share of renewables in total generation has increased from 6% in 2014-15 to 10% in 2018-19, India still needs to invest more than US $250 billion over the next decade.

## Energy Classification

### Primary and Secondary Energy

**Primary Sources:**
Primary sources are either found or stored in nature. It includes:

1. Coal
2. Oil
3. Natural Gas
4. Biomass (wood, etc.)
5. Also includes nuclear energy from radioactive substances, thermal energy.

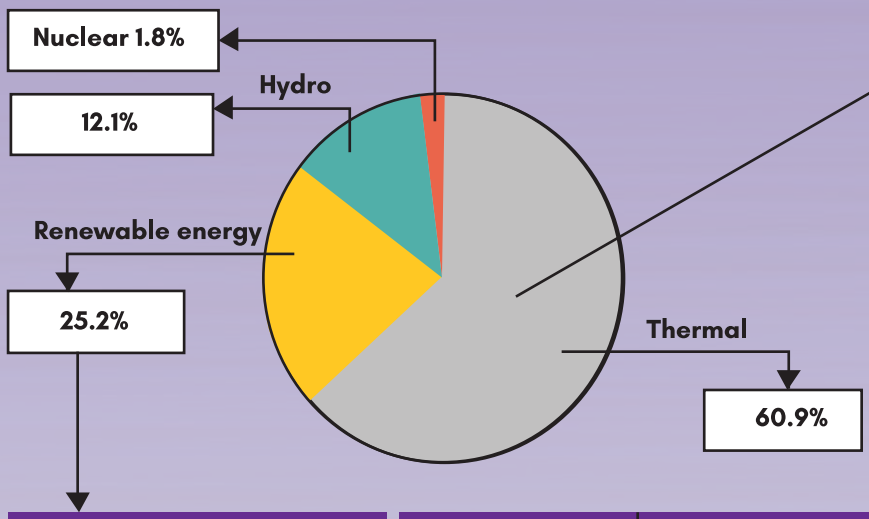
**Secondary Sources:**
Primary energy sources are mostly converted in industrial utilities into secondary energy sources example coal or oil or gas converted into thermal energy.

### Renewable and Non-Renewable Energy

**Renewable Energy:** This form of energy is obtained from inexhaustible sources. Renewable energy can be harnessed without the release of harmful pollutants. Example wind, solar, geothermal, tidal and hydroelectric.

**Non-Renewable Energy:**
These include conventional fossil fuels such as coal, oil and gas which are likely to deplete with use.

# Share of Energy Sources in Power Generation




**Thermal Further Include**
Coal: 52.6%
Lignite: 1.7%
Gas: 6.5%
Diesel 0.1%

India ranks 3rd in Renewable Energy Country Attractive Index in 2021, released by Ernst and Young.

**Renewable installed capacity in india**

- Wind Power: 39.44 GW
- Solar Power: 41.09 GW
- Bio Power: 10.34 GW
- Small Hydro Power: 4.79 GW

| 1,000+GW | 96.95 GW | 22% | 243% |
|---|---|---|---|
| Renewable energy potential in India | Installed renewable energy capacity (as of June 2021) | Share in total installed capacity | Increase in renewable installed capacity (FY 2013-14 to FY 2020-21) |

**Intended Nationally Determined Contributions (INDCs):**

Its target is to achieve about 40% cumulative electric power installed capacity from non-fossil-fuel based energy resources and to reduce the emission intensity of GDP by 33 to 35% from 2005 levels by 2030.

The country has also set an ambitious target to achieve a capacity of 175 GW worth of renewable energy by the end of 2022, which expands to 450 GW by 2030. This is the world's largest expansion plan in renewable energy.

# Renewable Energy and steps taken to boost them:

## 1. Solar Energy

Solar energy can be indirectly and directly converted into electricity through following two systems:

**Solar Thermal Power systems or Concentrating Solar Power systems**

This system concentrates rays of the Sun, using mirrors, lenses, etc. to heat the liquid to convert it into steam. The steam is then used to turn the turbine to create electricity.

Example:
Dhursar concentrating solar power (CSP) in Jaisalmer, Rajasthan.

**Solar Photovoltaic**

This system can directly convert the Sun light into electrical energy through use of photovoltaic cells.

Solar power plant can be:

- Solar power plant established on land
- A floating power plant, which has advantages like it save land resource and keep the plant structure cool and protect it from excessive dust.

## Steps taken by the Government to promote Solar energy

India's manufacturing policy recognizes **solar manufacturing as an industry of strategic importance.**

**National Solar Mission, 2010** aimed at installing 100 GW grid-connected plants by 2022. To achieve this target the government has launched various schemes:

- Solar Park scheme for setting up 50 solar parks and Ultra Mega Solar Power Projects.
- VGF scheme for setting up 5000 MW of grid connected projects, also has separate component (1000MW) for N-E states.
- Solar Rooftop Scheme to create 40,000 MW capacity by 2022.
- PM-KUSUM scheme
- Development of Solar city Programme to develop 60 cities/towns. With at least one city to a maximum of five in one state.
- A 25% capital subsidy for solar manufacturing units is available under the Modified Special Incentive Package Scheme (M-SIPS).

**International Solar Alliance:** Jointly launched by India and France in 2015 on sidelines of COP-21 of UNFCCC.

1. It is aimed at mobilizing 1000 billion US dollars in investments by 2030 for deploying 1000 GW of solar generation capacity. And undertake efforts to reduce the cost of finance
2. Its membership is open to **all members of the United Nations.**
3. It advocates standardization of equipment to reduce the cost of manufacturing through economy of scale.
4. It is headquartered at Gurugram, Haryana.
5. ISA has established five key programmes of action:
   - Scaling up solar application for agricultural use.
   - Affordable finance at scale.
   - Scaling up solar mini-grids.
   - Scaling up solar rooftop.
   - Scaling up solar e-mobility and storage.

**ISA secretariat launched:**

1. A **Solar Technology Application Research Centre (iSTAR-C)** to support capacity building efforts in the ISA member countries.
2. The ISA Solar Award **(Kalpana Chawla Solar Award)** to recognize solar scientists doing extraordinary work across ISA member countries

## 2. Wind Energy

The kinetic energy of the wind can be harnessed by converting it into mechanical energy or electrical energy using suitable devices such as turbines.

India has fourth highest installed capacity to produce wind energy after USA, China and Germany.

More than 95% of commercially exploitable wind energy potential is concentrated in seven states: Tamil Nadu, Gujarat, Maharashtra, Karnataka, Rajasthan, Andhra Pradesh, and Madhya Pradesh.

Tamil Nadu has the highest wind energy potential followed by Gujarat. Tamil Nadu also comes at first in wind power generation.

**International Renewable Energy Agency**

1. It is an intergovernmental organization, it is a principal platform for international cooperation, a Centre for excellence and a repository of policy, technology, and financial knowledge on renewable energy
2. It promotes widespread adoption of renewable energy including bioenergy, geothermal energy, hydropower, etc.
3. India is a member country of IRENA.

| Offshore Wind Power | Onshore wind power |
|---|---|
| It is the use of wind farms constructed in bodies of water, usually in the ocean on the continental shelf, to harvest wind energy. | It refers to the turbine located on land. |
| The benefit is that the wind speed is higher, and the wind is higher. | The advantage here is that these farms are located near consumption centers thus transmission losses are minimized. |

**Indian Renewable Energy Development Agency Limited (IREDA)**

1. It is a Mini Ratna Enterprise under administrative control of Ministry of New and Renewable Energy.
2. It is a Public Limited Company **established as Non-Banking Financial Institution in 1987** and is registered with the RBI.
3. It is engaged in promoting, developing, and extending financial assistance for setting up projects relating to new and renewable sources of energy and energy efficiency/conservation.

## 3. Tidal Energy

Tidal energy is power produced by the surge of ocean waters during the rise and fall of tides. Tidal energy is a renewable source of energy.

1. India has a potential of 8000 MW of tidal energy. This includes about 7000 MW in the Gulf of Cambay in Gujarat, 1200 MW in the Gulf of Kutch and hundred megawatts in Gangetic delta in the Sundarbans region of West Bengal.
2. India has no policy on tidal energy.
3. Tidal energy cannot be presently harnessed on commercial basis due to high capital cost.

## 4. Hydropower Energy

1. Uses force of falling water (Kinetic energy) to move the turbine and produce electrical energy.
2. It requires creation of dams, but not always, natural waterfalls can be used. It is relatively cheap source of energy.
3. Presently hydropower (large and small hydropower) contributes 12.1% in India's total energy mix.

### Hydropower Energy

**Large Hydro**

1. Power plants with capacity more than 25MW are classified as large hydro.
2. India is committed to reach 70,000 MW from this till 2030.
3. Large Hydro Projects (LHPs) have been declared as a Renewable Energy source.
4. New LHPs will also be covered within non–solar Renewable Purchase Obligation.

**Small Hydro**

1. Plants of 25 or below capacity are classified as Small Hydro.
2. The hilly states of India (North and North-East) have the highest potential for small hydro.
3. Small Hydro Programme (SHP) was launched to encourage state government and independent Private Producers to setup new power plants.
4. Small Hydro supply 4.79 GW presently.

## 5. Biomass Energy

Biomass or Bio-energy refers to the use of organic material to produce energy. Biomass is a renewable energy resource derived from plants and animal waste. Energy from biomass is released on burning or breaking the chemical bonds of organic molecules formed during photosynthesis. **Feedstock** is the organic material used to produce energy.

**For energy generation Feedstock is converted using any following conversion processes:**

1. **Combustion:** feedstock burned in presence of air to release heat.
2. **Gasification:** The process of using heat + pressure + partial combustion to convert feedstock into combustible gas mixture called syngas

**3. Pyrolysis:** The process of heating feedstock at high temperature in absence of oxygen. The feedstock is here converted into three things = (a.) Liquid called bio-oil (b.) Solid called biochar and (3.) Gas called Syngas.

**4. Anerobic digestion or Bio-digestion:** A process where bacteria break down organic material to create biogas. The remaining byproduct is called digestate, it makes a great fertilizer.

**5. Fermentation:** is the process of converting plant glucose into an alcohol called ethanol using yest.

**Ministry of New and Renewable Energy has launched following schemes for Biogas plants:**

**New National Biogas and Organic Manure Programme (NNBOMP):** to provide clean cooking fuel for kitchens, lightening and meeting other thermal and small power needs of farms/dairy farmers/individual households.

**Biogas Power Generation (off-grid) and Thermal Energy Application Program (BPGTP):** To promote biogas based decentralized renewable energy sources for power generation in the capacity range of 3 kW to 250 kW or thermal energy for heating/cooling applications from biogas generation.

**Galvanising Organic Bio - Agro Resources (GOBAR) Dhan Scheme:** It focus on managing and converting cattle dung and solid waste to form useful compost, biogas, and bio CNG and to keep village clean. It was launched under Swachh Bharat Mission (Gramin).

## 6. Biofuel

Biofuel is any fuel that is derived from **biomass**—that is **plant** or **algae** material or animal waste. Since such feedstock material can be replenished readily, biofuel is considered to be a source of **renewable energy**.

### Generations of Biofuels

**Generation I**

- Derived from food crops.
- Crops like wheat, sugarcane, soybean etc.
- Biochemical methods like fermentation or hydrolysis are employed to convert them to biofuels.
- Responsible for food v/s fuel debate.

**Generation II**

- Produced from non-food crops.
- lignocellulosic biomass such as wood, agricultural residues, forestry wastes, organic wastes etc.
- Biochemical and/or thermochemical methods are used to synthesize biofuels.
- "Biomass to liquid" fuel concept employed.

**Generation III**

- Derived from algae & other microbes.
- Cultivable land not required.
- Fastest growing feedstocks among all other sources.
- Biochemical and/or thermochemical methods are employed.
- Extensive downstream processing such as dewatering is required.

**Generation IV**

- An extension of generation III biofuels.
- Algae is modified via genetic engineering to alter the properties & cellular metabolism.
- High yield with high lipid containing algae.
- More $CO_2$ capture ability.
- Higher production rate.
- High intial investment but economical in long run.

To achieve energy security of the country, the government is targeting to reduce import dependence i.e., usage of fossil fuels by 10% from 2014-15 levels by the year 2022. For this a five pronged strategy has been adopted, among which **National Policy on Biofuels 2018** is also included.

**National Policy on Biofuels 2018**

As part of the policy a target of 20% blending of ethanol in petrol and 5% blending of biodiesel and diesel is to be achieved by 2030.

**As per the policy biofuels have been categorised as follows:**

**Bio-Ethanol:** These are the fuels produced from materials that have Sugar/Starch/Cellulose, such as Sugar cane, corn, bagasse respectively.

**Biodiesel:** It includes methyl or ethyl Easter of fatty acids derived from non–edible vegetable oil, used cooking oil, animal fat and bio oil.

**Advanced Biofuels:** include second-generation ethanol, drop in fuels, algae-based third generation biofuels, bio – CNG, bio – methanol, dimethyl ether (DME).

**Drop-in fuels:** These are fuels derived from biomass, agriculture residues, plastic waste, industrial waste, et cetera. Produced as per Indian standards that can be used in existing engines without modification.

**Bio-CNG:** These fuels are purified form of biogas produced from agricultural, human generated and animal waste.

**Pradhan Mantari JI-VAN (Jaiv Indhan – Vatavaran Anukool Fasal Awashesh Nivaran) Yojana:** Was introduced by Ministry of Petroleum and Natural Gas to provide financial support to Integrated Bioethanol Projects using lignocellulosic biomass and other renewable feedstock.

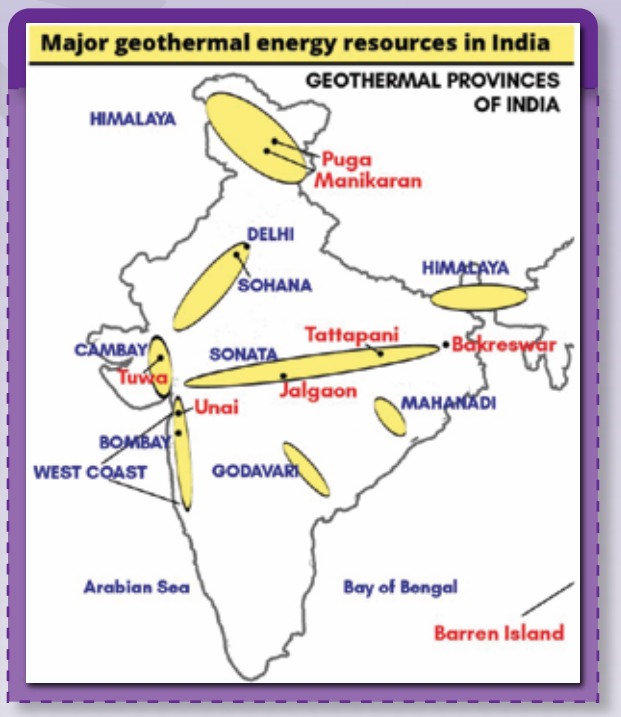
## 7. Geothermal Energy

Geothermal energy is the heat that comes from the sub-surface of the earth. To produce power from geothermal energy, wells are dug a mile deep into underground reservoirs to access the steam and hot water there, which can then be used to drive turbines connected to electricity generators.

There are four major types of Geothermal energy resources.
1. Hydrothermal
2. Geopressurized brines
3. Hot dry rocks
4. Magma

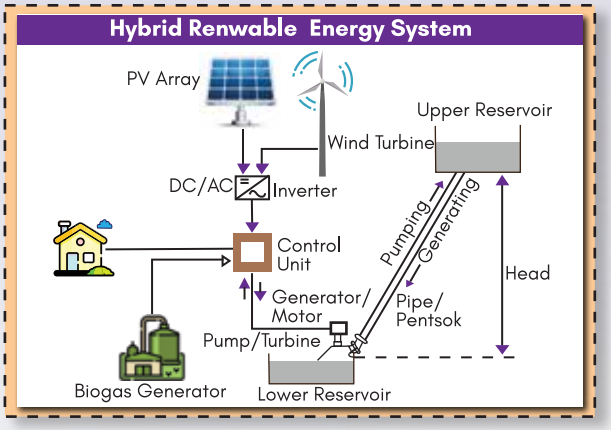
1. In India, North-western Himalayas and the western coast are considered geothermal areas.
2. Geological Survey of India has already identified more than 350 hot spring sites, which can be explored as areas to tap geothermal energy.
3. The estimated potential for geothermal energy in India is about 10000 MW.

1. There are seven geothermal provinces in India i.e., the Himalayas, Sohana, West coast, Cambay, Son-Narmada-Tapi (SONATA), Godavari, and Mahanadi.
2. **The Puga valley in the Ladakh region** is most promising geothermal field. It is being used mainly for poultry farming, mushroom cultivation, and pashmina-wool processing, all of which need higher temperature.




## 8. Hybrid Renewable Energy

It usually comprises of two or more renewable energy sources combined in such a way so as to provide an efficient system with appropriate energy conversion technology connected to feed power to local load or grid. Hybrid energy systems are still an emerging technology.



**Ministry of New & Renewable Energy finalized National Wind-Solar Hybrid Policy**

1. The main objective of the Policy is to provide a framework for promotion of large grid connected wind-solar PV hybrid system for optimal and efficient utilization of transmission infrastructure and land, reducing the variability in renewable power generation and achieving better grid stability.
2. Policy also aims to encourage new technologies, methods and way-outs involving combined operation of wind and solar PV plants.

## 9. Hydrogen Energy

When hydrogen gas burns in the air or in fuel cells, it combines with oxygen gas to produce non-polluting water vapour and fuel cells directly convert hydrogen into electricity.

**Hydrogen can be produced from** → A variety of domestic resources, such as natural gas, nuclear power, biomass, and renewable power like solar and wind. → In India, hydrogen is being commercially produced in the fertilizer industry, petroleum refining and chemical industries and as a by-product in chlor-alkali industries.

**Hydrogen** → is an energy carrier that can be used to store, move, and deliver energy produced from other sources. → These qualities make it an attractive fuel option for transportation and electricity generation applications. It can be used in cars, in houses, for portable power, and in many more applications.

**Hydrogen can be produced through**

1. Natural gas reforming (a thermal process)
2. Electrolysis: process by which **electric current** is passed through a substance to effect a chemical change.
3. Other methods include solar-driven and biological processes.

**Types of hydrogen depending upon process of extraction**

**Green hydrogen:**
It is derived by electrolysis of water, separating the hydrogen atom within it from oxygen using renewable energy (such as wind, solar or hydro) that eliminates emissions during process.

**Blue hydrogen:**
It is derived from natural gas through the process of steam methane reforming (SMR). SMR mixes natural gas with very hot steam, in the presence of a catalyst, where a chemical reaction creates hydrogen and carbon monoxide.

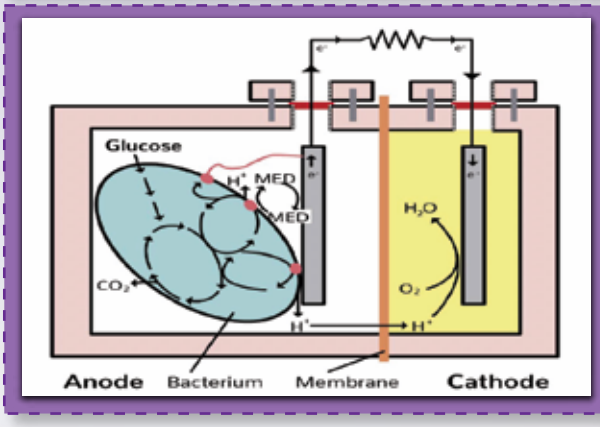
**Grey hydrogen:**
Hydrogen derived using fossil fuels is called as grey hydrogen.

## 10. Fuel Cell Technology

A fuel cell uses the chemical energy of hydrogen or other fuels to cleanly and efficiently produce electricity. If hydrogen is the fuel, the only products are electricity, water, and heat. Fuel cells are electrochemical devices that convert the chemical energy of a fuel directly and very efficiently into electricity (DC) and heat, thus doing away with combustion.

Fuel cells are unique in terms of the variety of their potential applications; they can use a wide range of fuels and feedstocks and can provide power for systems as large as a utility power station and as small as a laptop computer.

Recently (2020) India's first hydrogen fuel cell prototype car had a successful trial run.




**Microbial Fuel Cells**

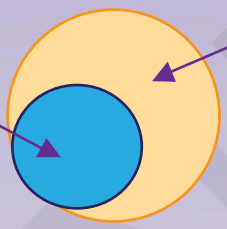
A microbial fuel cell (MFC) is a bio-electrochemical device that harnesses the power of respiring microbes to convert organic substrates directly into electrical energy.

**Advanced Chemistry Cells** (ACCs) are the new generation of advanced storage technologies that can store electric energy either as electrochemical or as chemical energy and convert it back to electric energy as and when required. Government recently approved Production Linked Incentive scheme "National Programme on Advanced Chemistry Cell Battery Storage".

# Energy Conservation

## Energy Conservation and Energy Efficiency are separate, but related concepts.

Energy efficiency is achieved when energy intensity in a specific product, process or area of production or consumption is reduced without affecting output, consumption or comfort levels. Energy efficiency will contribute to energy conservation and is therefore an integral part of energy conservation promotional policies.



Energy conservation is achieved when growth of energy consumption is reduced, measured in physical terms.

## Steps taken in India for Energy Conservation and Energy Efficiency

### 1. Energy Conservation Act, 2001

It provides for the legal framework, institutional arrangement, and a regulatory mechanism at the Central and State for energy efficiency drive in the country.

Five major provisions of the act relate to:
1. Designated Consumers
2. Standard and Labelling of Appliances
3. Energy Conservation Building Codes
4. Creation of institutional set up i.e., BEE
5. Establishment of Energy Conservation Fund

**The above act was amended through Energy Conservation (Amendment) Act in 2010, main amendments include:**

1. Central Government may issue the **energy savings certificate** to the designated consumer whose energy consumption is less than the prescribed norms and standards.
2. Designated consumer whose energy consumption is more than the prescribed norms and standards shall be entitled to purchase the **energy savings certificate** to comply with the prescribed norms and standards

**Bureau of Energy Efficiency**

1. A statutory body under the Ministry of Power, created under the provisions of the Energy Conservation Act, 2001.
2. It assists in developing policies and strategies with the primary objective of reducing the energy intensity of the Indian economy.
3. It co-ordinates with designated consumers and designated agencies to identify and utilize the existing resources and infrastructure, in performing the functions assigned to it under the Energy Conservation Act, 2001.
4. Star-labelling program of BEE seeks to provide consumers with an informed choice about energy saving and thereby the cost saving potential of the marketed household and other equipment.
5. **Star-labelling scheme** targets display of energy performance labels on high-energy end-use equipment & appliances and lay down minimum energy performance standards.
6. It is mandatory for all RACs along with LED lamps, Colour TV, Electric Geysers, etc.

**National Energy Conservation Awards (NECA):**

It is given every year on 14th December by Ministry of Power in association with Bureau of Energy Efficiency to recognize the efforts of industry and other establishments towards promoting energy efficiency.

## 2. Unlocking National Energy Efficiency Potential (UNNATEE)

Bureau of Energy Efficiency (BEE) has developed a national strategy document titled UNNATEE towards developing an energy-efficient nation (2017-2031)

**UNNATEE** Implementation strategy involves:

1. Favorable regulations.
2. Institutional framework for strong enforcement mechanisms at state levels.
3. Availability of finance.
4. Use of technology such as Internet of Things and Blockchain to bring an energy revolution.
5. Stakeholder participation for faster adaptation and implementation.
6. Data collection.
7. Setting a state wise target.
8. Centre of excellence for industries to increase research and development in separate sectors.

## 3. Steps taken by the government for Energy Efficiency and conservation in buildings

Niti Aayog indicates that the electricity consumption for the residential sector is expected to increase 6-13 times by 2047.

**1. Energy Conservation and Building Code Residential: ECBC – R**

- BEE envisaged a phased approach for the development of the residential building energy conservation code. Making houses energy efficient is certainly a way of avoiding a long term futile electricity consumption liability in residential buildings.
- Its first part was launched in 2018 by the name **Eco-Niwas Samhita.**
  - It was launched by Ministry of Power and is applicable to all residential buildings projects built on plot area ≥ 500 $m^2$.
  - The code aims for promoting design and construction of homes including apartments and townships to give the benefits of energy efficiency to the occupants.
  - The code has been developed to set minimum building envelop performance standard to limit heat gains and heat loss as well as ensuring natural ventilation and light.

**2. Energy Conservation and Building Code Commercial: ECBC – C**

The code is given by Bureau of Energy Efficiency for providing minimum requirements for energy-efficient design and construction of building. It is applicable to buildings or building complexes that have a connected load of hundred kilowatt or greater and are intended to be used for commercial purposes. Residential buildings are not covered by the code.

**3. Energy Efficiency label for Residential Building:**

It was launched by Ministry of Power in 2019. It aims to provide a benchmark of comparison of houses on energy efficiency standards to create consumer driven market transformation solution.

**4. Star rating programme** by Ministry of Power was launched for star rating of commercial buildings in India in 2019. This program rates building on 1 to 5 scale, with five-star level being most efficient.

## 4. National Mission for Enhanced Energy Efficiency (NMEEE)

**NMEEE Implemented since 2011**

- Is one of the 8 missions under National Action Plan for Climate Change.
- It aims to strengthen market for energy efficiency by creating conducive regulatory and policy regime.
- It focuses on innovation and sustainable business models.
- THE BEE and Energy Efficiency Services Limited (EESL) helps in its implementation.

**NMEEE Consist of four initiatives**

**Perform Achieve and Trade Scheme (PAT):** a market assisted compliance mechanism to accelerate implementation of cost-effective improvements in energy efficiency in large energy-intensive industries such as Iron and Steel, through Energy Saving Certificates (ESCerts) that could be traded.

**Market Transformation for Energy Efficiency (MTEE):** Accelerating the shift to energy efficient appliances in specific application through innovative measures to make the products more affordable.
It includes two sub-schemes within it-
1.) Bachat Lamp Yojana.
2.)Super-Efficient Equipment Programme (SEEP).

**Energy Efficiency Financing Platform (EEFP):** It facilitates Financial Institutions to invest in Energy Efficiency Projects and Programs.

**Framework for Energy Efficient Economic Development (FEEED):** Developing fiscal instruments to leverage financing for Energy Efficiency through risk mitigation:
- Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE).
- Venture Capital Fund for Energy Efficiency (VCFEE) to promote energy efficiency.

## 5. Energy efficiency and Transport Sector

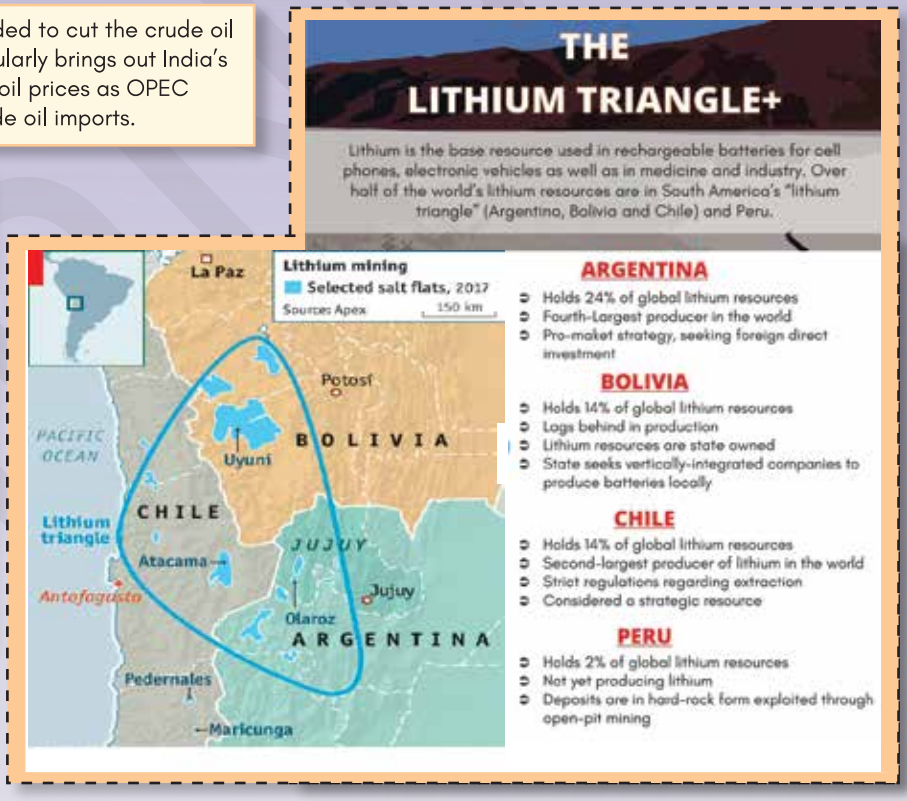
This sector accounts for 18% of total energy consumption in India. This translates to an estimated 94 million tonnes of oil equivalent (MTOE) energy. It also contributes an estimated 142 million tonnes of CO2 emissions annually (road transport alone contributing 123 million tonnes).

The OPEC Plus arrangement has recently decided to cut the crude oil production during 2020 and 2022. This particularly brings out India's vulnerability to the volatile international crude oil prices as OPEC makes up about 83% of the country's total crude oil imports.

Electric Vehicles a viable alternative to

- To addresses the issue of energy security → Shift towards EVs will help cut oil imports (India has set targets to cut oil imports by 10% by 2022).
- And to addresses Green House Gas emission → Electric mobility comes with zero or ultra-low tailpipe emissions of local air pollutants and much lower noise.

Can provide a major boost to the economic and industrial competitiveness, attracting investments.




China, Chile, Argentina, Australia accounts for 95% of the Lithium-Ion Battery production.

**India's context**

- India needs to significantly boost its battery production capacity, as it is heavily dependent of imports.
- Availability of adequate Charging Infrastructure is a key requirement
- Electric Vehicle accounts for less than 1% of total Vehicle sales.

**Steps taken in India to promote Electric Vehicles**

National Electric Mobility Mission Plan (NEMMP), 2020.

The mission provides the vision and the roadmap for the faster adoption of electric vehicles and their manufacturing in the country.

NEMMP 2020 includes Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) Scheme launched by Department of Heavy Industry in 2015.

National Mission on Transformative Mobility and Battery Storage, 2019.

The mission will support and implement Phased Manufacturing Programme (PMP) which will be valid for 5 years till 2024 for large scale, export competitive integrated batteries and cell manufacturing Giga plants in India.

The Mission will have 'Make in India' strategy for Electric Vehicle components and battery technologies. It will localize production across entire Electric vehicle value chain.

Charging Infrastructure for Electric Vehicles – Guidelines and Standards, 2019 with an aim to enable faster adoption of EVs in India.

It mentions the roles and responsibilities of various stakeholders at Central & State level, for expediting the development of public EV charging infrastructure across the country.

**Ministry of Power** has designated **Bureau of Energy Efficiency (BEE) as the Central Nodal Agency (CNA)** for the National-level rollout of charging infrastructure in the country.

It will have an inter-ministerial steering committee, chaired by CEO, NITI Aayog that will coordinate among key stakeholders.

## 6. Energy Efficiency and Agriculture

While about 70% of Indian electricity is carbon-based, a quarter of the nation's consumption goes into agriculture, to extract groundwater for irrigation. Improving the energy efficiency of Indian agriculture is thus a critical issue from both a climate change and energy security perspective.

### Steps taken by Government

National Mission for Sustainable Agriculture (NMSA), the mission is operational from the year 2014-15 and includes:

**On Farm Water Management (OFWM):** Its objective is enhancing water use efficiency by promoting technological interventions like drip & sprinkler technologies. These activities have been subsumed under the **'Per Drop More Crop (PDMC)' component of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY).**

**Rainfed Area Development Programme:** The programme focuses on Integrated Farming System for enhancing productivity and minimizing risks associated with climatic variability.

**Soil Health Management (SHM):** It aims at promoting Integrated Nutrient Management (INM) for improving soil health and its productivity and strengthening of soil and fertilizer testing facilities for the same.